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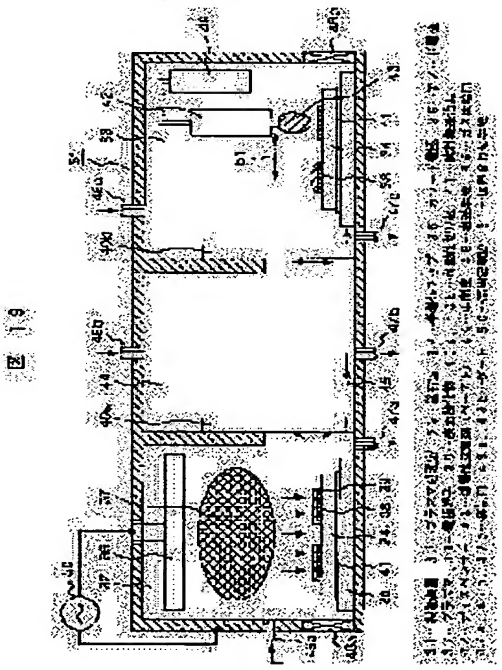
(54) SEMICONDUCTOR DEVICE MANUFACTURING METHOD AND DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a manufacturing method and an equipment for a semiconductor device in which electrode terminals can be markedly lessened in connection resistance between them even if the conventional Al is used as electrode material when the electrode terminals of the semiconductor device are connected together with conductive adhesive agent.
SOLUTION: A semiconductor chip 34 serving as a specimen is installed on a cathode electrode 35 in a plasma processing chamber 32. An oxide 39 on the surface of the electrode terminal 38 of the specimen 34 is removed by plasma 37 generated between the cathode electrode 35 and an anode electrode 36. The specimen is transferred into an application chamber 33 via an intermediate chamber 44 in which an inert gas is fed, and conductive adhesive agent paste 43 is applied on the surface of the electrode terminal 38 in an inert gas of an atmospheric pressure, being fed from a dispenser 42. The oxide 39 of the electrode terminal 38 is removed, then the conductive adhesive paste layer 43 can be formed on the surface of the electrode terminal 38 without coming into contact with oxygen contained in the air, so that a semiconductor device of small connection resistance can be manufactured.



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CLAIMS

[Claim(s)]
[Claim 1] The process which applies electroconductive glue to the electrode terminal of a semiconductor device, and the process which carries out alignment of the electrode terminal with which said electroconductive glue was applied on the electrode terminal on a mounting substrate, It is the manufacture approach of a semiconductor device of having the process which forms an electroconductive glue layer between said two-electrodes terminals which carried out alignment, and performs electrical installation by hardening said electroconductive glue. the process which applies electroconductive glue to the electrode terminal of said semiconductor device Without contacting into oxygen the process which removes the oxide currently formed in the front face by carrying out plasma treatment of the electrode terminal front face of said semiconductor device, and said electrode surface by which plasma treatment was carried out in a non-oxidizing gas ambient atmosphere The manufacture approach of the semiconductor device characterized by including the process which applies electroconductive glue to the front face.
[Claim 2] The manufacture approach of the semiconductor device according to claim 1 characterized by facing carrying out plasma treatment of said electrode terminal front face, and using the gas of nitrogen or a periodic table zero group element as a type of gas.
[Claim 3] The non-oxidizing gas ambient atmosphere in the process which applies said electroconductive glue is the manufacture approach of the semiconductor device according to claim 1 characterized by being nitrogen-gas-atmosphere mind, the gas ambient atmosphere of a periodic table zero group element, or the gas ambient atmosphere that does not contain oxygen including a reducibility element.
[Claim 4] The manufacture approach of the semiconductor device according to claim 1 characterized by hardening said electroconductive glue in an inert gas ambient atmosphere in the process which forms an electroconductive glue layer between said two-electrodes terminals, and performs electrical installation by hardening said electroconductive glue.
[Claim 5] The process which applies electroconductive glue to the electrode terminal of a semiconductor device, and the process which carries out alignment of the electrode terminal with which said electroconductive glue was applied on the electrode terminal on a mounting substrate, It is the manufacture approach of a semiconductor device of having the process which forms an electroconductive glue layer between said two-electrodes terminals by which alignment was carried out, and performs electrical installation by hardening said electroconductive glue. The process which applies electroconductive glue to the electrode terminal of said semiconductor device The manufacture approach of the semiconductor device characterized by including the process which applies electroconductive glue to the electrode terminal of a semiconductor device in atmospheric air, and the process which removes an oxide from the front face of an electrode terminal mechanically under the condition in which said electroconductive glue covered the electrode terminal top, and intercepted the open air by it.
[Claim 6] Claim 1 which said semiconductor device is the semiconductor chip separated from the wafer, and is characterized by having the 1st substrate in which said mounting substrate carries a semiconductor chip, and the 2nd substrate carrying said 1st substrate in which said semiconductor chip was carried thru/or the manufacture approach of the semiconductor device

any one publication of five.
[Claim 7] The plasma treatment room which has the plasma generating means and gas supply opening which carry out plasma treatment of the electrode terminal front face of a semiconductor device under predetermined reduced pressure, and an exhaust port, The middle room relayed in the non-oxidizing gas ambient atmosphere where the semiconductor device by which plasma treatment was carried out at said plasma treatment room was decompressed, The manufacturing installation of the semiconductor device characterized by having the spreading room which has a means to apply electroconductive glue to the electrode terminal front face of a semiconductor device from which said middle room was relayed in the non-oxidizing gas ambient atmosphere under ordinary pressure, and the conveyance means which carries out sequential conveyance of the semiconductor device from said plasma treatment room to a spreading room.
[Claim 8] The manufacturing installation of the semiconductor device according to claim 7 characterized by constituting the above-mentioned plasma generating means from plasma treatment equipment by high frequency discharge.
[Claim 9] The manufacturing installation of the semiconductor device according to claim 7 characterized by constituting the above-mentioned plasma generating means from plasma treatment equipment by microwave discharge.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the semi-conductor manufacture approach and manufacturing installation which used electroconductive glue for the connection between electrode terminals of a semiconductor device.
[0002]
[Description of the Prior Art] The connection between electrode terminals of the semiconductor device using the conventional electroconductive glue applied and hardened direct electroconductive glue to gold or a gold plate electrode terminal, and has connected it to it electrically and mechanically so that JP,6-224259,A and JP,8-227913,A may see. The connection between terminals by this electroconductive glue had the advantage referred to as that a washing process becomes unnecessary and serves as the manufacture approach of low cost in order to be able to connect at low temperature compared with a soldered joint etc. and not to use flux.
[0003]
[Problem(s) to be Solved by the Invention] However, there is a problem that the electric resistance between the terminals connected with electroconductive glue becomes large, and the electric engine performance cannot be satisfied according to the class of metal used for an electrode terminal.
[0004] In the case of the usual cheap electrode material called especially copper and aluminum, the variation with it arose, and the dependability of a semiconductor device was remarkably reduced to it. [large and resistance and] [to connection resistance] [big]
[0005] Increase and variation of this resistance are a decisive problem which obstructs utilization as densification of the semiconductor device is carried out. Therefore, the approach of using gold or gold plate for an electrode terminal metal conventionally, and connecting with electroconductive glue is performed. Thereby, although increase of the resistance of the electrode terminal strapping section is lost, the technical problem that a semiconductor device becomes expensive remains.
[0006] Therefore, the purpose of this invention is to cancel the above-mentioned conventional trouble, and is to offer the manufacture approach of the semiconductor device [metals /, such as aluminum other than gold (for example, copper), / ordinary / cheap] usable as an electrode material using electroconductive glue, and a manufacturing installation. Thereby, the semiconductor device of the low cost which raised the resistance property between electrode terminal strapping can be obtained easily.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention person etc. did experiment examination variously about the connection resistance at the time of using electroconductive glue and using ordinary cheap metals, such as copper and aluminum, as an electrode terminal.
[0008] Consequently, it turned out that it is said that it is in dirt and a scaling object existing in that the volume resistivity of the hardened material of electroconductive glue is large, and an

electrode terminal front face as a cause by which the electric resistance between the electrode terminals connected with electroconductive glue becomes large.
[0009] It became clear the increment in resistance with the biggest oxide formed in the electrode terminal front face also especially in it that a lifting and a surface of metal generated a scaling object in several seconds in atmospheric air.
[0010] This invention is made based on these knowledge, and describes the description of the manufacture approach of the semiconductor device of this invention below.
[0011] The description on the manufacture approach is in the process which applies electroconductive glue to the electrode terminal of a semiconductor device to remove an oxide from the front face of the metal which constitutes an electrode terminal. There are two approaches among the removal approaches of an oxide, one of them is the plasma treatment approach which used rare gas or nitrogen gas, such as Ar, and Ar+H2, Xe, and one is the approach of shaving off mechanically [others].
[0012] By ion etching, in the case of the plasma treatment approach, an oxide can be removed from an electrode terminal front face, and a metal side can be exposed in it. It faces applying electroconductive glue to this exposed surface of metal, and it becomes important to apply in the non-oxidizing gas ambient atmosphere which eliminated oxygen so that a surface of metal might not oxidize again.
[0013] Atmospheric pressure is sufficient as the gas pressure of the ambient atmosphere to apply, and it is desirable as a non-oxidizing gas ambient atmosphere to carry out in reducing gas ambient atmospheres, such as inert gas, such as nitrogen and a periodic table zero group element (rare gas), or hydrogen.
[0014] Moreover, in the case of the approach of shaving [front face / electrode terminal] an oxide mechanically, the electroconductive glue of a daily dose required for connection is beforehand applied to the electrode terminal front face, and with this electroconductive glue, where an electrode terminal front face is intercepted, fixtures which have sharp tip structure, such as a metal and ceramics, are applied to an electrode terminal front face, and are shaved [open air] mechanically.
[0015] Since in the case of this approach an oxide is mechanically shaved off where electroconductive glue is beforehand applied to an electrode terminal front face, and the electrode terminal front face is covered with electroconductive glue during removal of an oxide, and after removal, it does not oxidize again. Therefore, the ambient atmosphere to apply is also good in atmospheric air, and it is not necessary to necessarily make it into a non-oxidizing gas ambient atmosphere.
[0016] In the process which applies electroconductive glue to an electrode terminal front face in short, after removing an oxide in the plasma treatment approach, it is important to apply electroconductive glue, without contacting an electrode terminal front face into oxygen during removal in the approach of shaving off mechanically.
[0017] In the manufacture approach of this invention, alignment of the electrode terminal with which electroconductive glue was applied is carried out to the electrode terminal on a mounting substrate, and it is characteristic also in the process which forms an electroconductive glue layer between two electrodes, and performs electrical installation. Generally, although the connection process using this kind of electroconductive glue heat-hardens the resinous principle of adhesives and is performed in atmospheric air, it is desirable to harden in inert gas ambient atmospheres, such as nitrogen gas and rare gas, in this invention.
[0018] Moreover, the description of the manufacturing installation of a semiconductor device which can attain the purpose of above-mentioned this invention ** The plasma treatment room which has the plasma generating means and gas supply opening which carry out plasma treatment of the electrode terminal front face of a semiconductor device under predetermined reduced pressure, and an exhaust port, ** The middle room relayed in the non-oxidizing gas ambient atmosphere where the semiconductor device by which plasma treatment was carried out at said plasma treatment room was decompressed, ** the spreading room which has a means to apply electroconductive glue to the electrode terminal front face of a semiconductor device from which said middle room was relayed in the non-oxidizing gas ambient atmosphere under ordinary

pressure, and ** -- be in a point equipped with the conveyance means which carries out sequential conveyance of the semiconductor device from said plasma treatment room to a spreading room.
[0019]
[Embodiment of the Invention] As a target semiconductor device, there are IC chip, a capacitor chip, BGA (Ball Grid Array), a mounting substrate, etc., and this invention also contains the solder ball later formed in the electrode of a chip and the substrate for chip loading (wiring substrate for mounting), and the electrode as an electrode terminal. Moreover, as a metal of an electrode terminal, there are Cu, aluminum, Ag, Sn, Pb, SnPb, AgPt, SnAg, SnBi, etc.
[0020] The plasma treatment approach previously explained as one of the approaches which removes the metallic oxide on the front face of an electrode terminal can be enforced with the well-known plasma treatment equipments equipped with the electrode of for example, a monotonous-in parallel mold, such as RF plasma treatment equipment and microwave discharge plasma treatment equipment.
[0021] As the method of application of electroconductive glue, there are the dispenser method, print processes, a replica method, etc. After applying, heat hardening is taken out and carried out into atmospheric air. In order to prevent the contact to the surface of metal of the oxygen in the inside of an elevated temperature until a paste hardens, it is desirable to also perform heat hardening in an inert gas ambient atmosphere.
[0022] A terminal front face is shaved off by the metal which has sharp tip structure as an approach of removing mechanically the metallic oxide on the front face of an electrode terminal, a ceramic, etc. Moreover, an oxide film is removed, when a tip puts a pressure with fixtures, such as a metal on the shape of a round head, and a flat surface, and a ceramic, and moves in a terminal side. This is for the metal particles in electroconductive glue (for example, Ag etc.) to destroy the oxide film on the front face of an electrode terminal with a pressure.
[0023] Since the surface of metal newly made since electroconductive glue was applied to the electrode terminal front face is immediately covered with electroconductive glue after oxide-film removal, oxidation is prevented without contacting the oxygen in atmospheric air.
[0024] In the case of IC chip, after performing spreading of such electroconductive glue, and the process of hardening on a wafer, they may be divided into an individual chip.
[0025] Moreover, the typical manufacturing installation of this invention is equipped with the plasma treatment room which has the plasma generating means and gas supply opening which carry out plasma treatment of the electrode terminal front face of ** semiconductor device under predetermined reduced pressure, and an exhaust port in order to remove the oxide on the front face of an electrode terminal in a semiconductor device, as mentioned above. rare gas or nitrogen gas, such as Ar from gas supply opening, and Ar+H2, Xe, -- the plasma treatment interior of a room -- supplying . From an exhaust port, it exhausts with an exhaust air pump and the pressure of the plasma treatment interior of a room is set as 1-100Pa.
[0026] A plasma generating means consists of well-known plasma treatment equipments, such as RF plasma treatment equipment equipped with the electrode of an RF generator and a monotonous-in parallel mold, or microwave discharge plasma treatment equipment equipped with the microwave power source and the discharge room.
[0027] The middle room of the above-mentioned ** is a junction room prepared between the plasma treatment room and the spreading room of the electroconductive glue of **, and in case the semiconductor device by which plasma treatment was carried out is conveyed from a plasma treatment room to the spreading interior of a room of atmospheric pressure, it is prepared as a buffering area so that the pressure of a plasma treatment room may not go abruptly up.
[0028] Therefore, in case the semiconductor device by which gas supply opening and the exhaust port which supply a non-oxidizing gas were established, and plasma treatment was carried out is conveyed from a plasma treatment room to the spreading interior of a room of atmospheric pressure so that 1 set of gates which carry in a semiconductor device to a middle room and it is made to take out, and the electrode terminal front face of the semiconductor device by which plasma treatment was carried out may not be oxidized, it is constituted so that the interior of a room may be held in a non-oxidizing gas ambient atmosphere.

[0029] From gas supply opening, reducing gas, such as inert gas, such as nitrogen gas and rare gas, or hydrogen gas which does not contain oxygen depending on the case, is supplied as a non-oxidizing gas. What is necessary is for gas pressure to be higher than the pressure of the plasma treatment interior of a room, for example, just to set it as about 100-500Pa.
[0030] A means to apply electroconductive glue to the electrode terminal front face of a semiconductor device from which the middle room was relayed in the non-oxidizing gas ambient atmosphere of atmospheric pressure is formed in the spreading room of the above-mentioned **. As this means to apply, it has the device which supplies the electroconductive glue of the specified quantity to the electrode terminal front face of a semiconductor device from the dispenser connected to the coating liquid tank, for example, and a dispenser and a semiconductor device are moved relatively, and it also has the device in which alignment of a dispenser and the electrode terminal which should be applied can be performed.
[0031] Moreover, in order to make the interior of a room as well as a middle room into a non-oxidizing gas ambient atmosphere, it has gas supply opening and the exhaust port for supplying reducing gas, such as hydrogen gas, for example which do not contain oxygen depending on inert gas, such as nitrogen gas and rare gas, or the case.
[0032] The conveyance means of the above-mentioned ** carries out sequential conveyance of the semiconductor device from a plasma treatment room to a spreading room, and has composition which can move a semiconductor device to ** intermittently or continuously from each **.
[0033] As explained above, the point made the configuration processed in the ambient atmosphere (non-oxidizing atmosphere) which removed oxygen gas consistently is one of the descriptions so that an electrode terminal front face may not oxidize again, after the manufacturing installation of this invention removes the oxide on the front face of an electrode terminal at a plasma treatment room until electroconductive glue is applied at a spreading room.
[0034]
[Example] Hereafter, the typical example of this invention is explained according to a drawing.
<Example 1> Drawing 1 - drawing 5 are drawings showing the 1st example of this invention, and, thereby, explain the manufacture process of an example. Drawing 1 is the sectional view of a semiconductor chip 1, the semiconductor chip 1 is turning the circuit side down, and the electrode terminal 2 of Cu is formed. The oxide film 3 of Cu is generating in the front face of an electrode terminal 2.
[0035] Drawing 2 is the sectional view from which the oxide film 3 of Cu was removed by plasma treatment. That is, removal of an oxide film 3 was performed with Ar plasma of the conditions of 10Pa of processing pressure force using the RF plasma treatment equipment (an example 5 explains the detail of a manufacturing installation) of the frequency of 13.56MHz, and the monotonous-in parallel mold of output 500W.
[0036] Drawing 3 is the sectional view which applied and formed the commercial electroconductive glue paste 4 in the front face of the electrode terminal 2 from which the oxide was removed by the above-mentioned plasma treatment. On the occasion of spreading of the electroconductive glue paste 4, after removal of an oxide film 3, the front face of the Cu electrode terminal 2 was not contacted to atmospheric air, and the electroconductive glue paste 4 was formed on the Cu electrode terminal 2 in N2 ambient atmosphere.
[0037] The commercial electroconductive glue paste 4 consists of an epoxy resin and an Ag particle, and is isotropic electroconductive glue. The dispenser performed formation of the electroconductive glue paste 4. Drawing 4 is the sectional view which carried the semiconductor chip 1 in the mounting substrate 5. The electrode terminal 6 and alignment of Au which took out in [after forming the electroconductive glue paste 4] atmospheric air, and were formed in the mounting substrate 5 were performed, and the semiconductor chip 1 was carried in the mounting substrate 5. Heat hardening of this was carried out on 150-degree-C conditions of 1 hour in N2 ambient atmosphere.
[0038] Drawing 5 is the sectional view in which under-filling 7 was formed. The under-filling 7 of an epoxy resin was poured into the gap of a semiconductor chip 1 and the mounting substrate 5, and it hardened in 150-degree-C 1 hour after connecting between the terminals of the mounting

substrate 5 with the semiconductor chip 1 by the above-mentioned heat hardening.
[0039] Thus, the specific resistance between the electrode terminals 2-6 of the semiconductor device of manufactured this example was contrasted with the example of a comparison which did not perform plasma treatment. Consequently, although the specific resistance of this example was 10-3 - 10-4ohmcm, in the case of the example of a comparison, it was as high as 10-2 - 10+4-ohmcm, and connection resistance was remarkably reduced by this invention. This enabled it to use copper for the electrode terminal of a semiconductor chip instead of gold.
[0040] <Example 2> Drawing 6 - drawing 11 explain the 2nd example. Drawing 6 is the sectional view of the ball grid array substrate 9 carrying a semiconductor chip 8. The solder ball 11 of PbSn is formed in the electrode 10 of a substrate 9, it gets down, and the oxide 12 of PbSn is generated by the front face.
[0041] Drawing 7 is the sectional view from which the oxide 12 of solder ball 11 front face was removed. Plasma treatment performed removal of an oxide film 12 like the example 1. That is, it carried out with Ar plasma of the conditions of 8Pa of processing pressure force using the RF plasma treatment equipment (an example 5 explains the detail of a manufacturing installation) of the frequency of 13.56MHz, and the monotonous-in parallel mold of output 400W.
[0042] Drawing 8 is the sectional view in which the isotropic electroconductive glue paste 13 of commercial Ag restoration epoxy resin was formed. Formation of the electroconductive glue paste 4 was performed with the replica method which makes the solder ball 11 push and adhere to the paste 4 of fixed thickness.
[0043] Drawing 9 is the sectional view of the 2nd mounting substrate 14 which carries the substrate 9 (it becomes the 1st mounting substrate) carrying the above-mentioned semiconductor chip 8. The oxide 16 of PbSn is formed in the front face of the electrode 15 of PbSn of the mounting substrate 14.
[0044] Drawing 10 is the sectional view from which the oxide 16 on an electrode 15 was removed. The oxide film 16 was removed with Ar plasma like the conditions of above-mentioned drawing 7 , and it held in N2 ambient atmosphere so that it might not oxidize again after that.
[0045] Drawing 11 is the sectional view of the mounting substrate 14 carrying the ball grid array substrate 9. Heat hardening was carried out in N2 ambient atmosphere in 140-degree-C 1 hour after alignment and loading. Resistance was remarkably reduced by connection of the 1st mounting substrate connected by this and the 2nd mounting substrate like the example 1.
[0046] <Example 3> Drawing 12 - drawing 17 R> 7 explain the 3rd example. Drawing 12 is the sectional view of a wafer 17 in which many semiconductor devices were formed, the electrode terminal 2 of Cu is formed in each semiconductor device, and the oxide film 3 of Cu is generating it in the front face.
[0047] Drawing 13 is the sectional view from which the oxide film 3 of Cu was removed. Removal of an oxide film 3 was performed like the example 1 with Ar plasma of the conditions of RF output 500W and 10Pa of processing pressure force.
[0048] Drawing 14 is the sectional view in which the electroconductive glue paste 4 was formed on the electrode terminal front face which removed the oxide. After removal of this oxide film 3 did not contact the Cu electrode terminal 2 to atmospheric air, formed the electroconductive glue paste 20 by printing on the Cu electrode terminal 18 in N2 ambient atmosphere, and hardened it in N2 in 150-degree-C 1 hour.
[0049] Drawing 15 is the sectional view of the semiconductor chip 1 which cut the wafer 17 of drawing 14 and was obtained. Drawing 16 is the sectional view of the mounting substrate 5. The electroconductive glue paste 24 is formed by printing on the electrode terminal 6 of Au.
[0050] The drawing 17 semiconductor chip 1 was carried in the mounting substrate 5, electroconductive glue 24 was hardened in N2, under-filling 7 was poured in, and heat hardening was carried out in 150-degree-C 1 hour. Thus, the connection resistance between the electrode terminals 2-6 of the obtained semiconductor chip 1 and the mounting substrate 5 was almost equivalent to examples 1 and 2.
[0051] In the above example, although each carried out plasma treatment by Ar gas to oxide removal, even if it transposes a type of gas to other rare gas or N2 gas, the same effectiveness is acquired.

[0052] <Example 4> Cross-section process drawing of drawing 18 explains the 4th example. The oxide 3 is generating drawing 18 (a) on the front face of the Cu electrode 2 on a semiconductor chip 1. Although a fluidity is on this oxide 28, spreading formation of the viscous high electroconductive glue paste 4 is carried out comparatively.
[0053] As shown in drawing 18 (b), the oxide 3 which is in contact with the paste 4 with the metal fixture 30 is shaved off mechanically. Since an oxide is shaved off where the front face of an electrode 2 is always covered with a paste 4, the metal side exposed even if the oxide was removed is intercepted with a paste 4, and does not contact atmospheric air.
[0054] Thus, as shown in drawing 18 (c), Cu metal side and the paste 4 of an electrode 2 from which the oxide was removed contact. All of these processes are performed in atmospheric air. Then, connection with a mounting substrate was made like the process shown in examples 1-3.
[0055] <Example 5> Drawing 19 explains the 5th example. Drawing 19 shows the outline sectional view of the equipment 31 for manufacturing a semiconductor device with small resistance by electroconductive glue connection.
[0056] First, if it explains from the configuration of this manufacturing installation, this manufacturing installation 31 is equipped with the plasma treatment room 32, the spreading room 33 of electroconductive glue, the middle room 44 that connects these two processing rooms, and the conveyance device 45 which carries out sequential conveyance of either [at least] a semiconductor device or a mounting substrate intermittently or continuously in these 3 interior of a room like illustration.
[0057] The plasma generating means is formed in the plasma treatment room 32, and this example shows the example of the high-frequency-discharge plasma generator of a monotonous-in parallel mold. That is, this plasma generating means is equipped with the conveyance fixture 34 which served as gas supply opening 46a which supplies RF generator 50, the anode electrode 36, the cathode electrode 35, and the gas for plasma generating indoors, exhaust-port 47b connected to the exhaust air pump which is not illustrated, and the sample base used as a processed sample in which a semiconductor chip 34 is laid, for example. In addition, 48a shows the 1st gate which carries in a sample indoors.
[0058] The microwave which makes the magnetron of not only this high-frequency-discharge plasma generator but in addition to this common knowledge the source of an oscillation as a plasma generating means can also be transposed to the microwave discharge plasma generator which makes a waveguide discharge within the through discharge tube.
[0059] The middle room 44 is the space divided considering the wall surface of the plasma treatment room 32 and the spreading room 33 as a septum, and these two septa are formed with the movable dashboards 40a and 40b. 46b is gas supply opening and prevents the reoxidation of the electrode terminal 38 of a sample 34 by which supplied the non-oxidizing gas (reducing gas, such as inert gas, such as nitrogen gas and rare gas, or hydrogen) indoors, and plasma treatment was already carried out.
[0060] This middle room 44 is formed in order not to carry in to the next spreading room 33 directly, but to relay the middle room 44 used as a buffering area, since differential pressure with the spreading room 33 processed with the pressure and atmospheric pressure of the plasma treatment room 32 decompressed in order to fulfill discharge conditions is large, and to raise a pressure gradually.
[0061] Therefore, in case a sample 34 is conveyed in the spreading room 33 from the plasma treatment room 32, after closing the movable dashboards 40a and 40b beforehand, opening movable dashboard 40a in the condition of having decompressed the inside of the middle room 44 to the predetermined pressure, and having held in the non-oxidizing gas ambient atmosphere, carrying in a sample 34 in the middle room 44 and closing movable dashboard 40a, movable dashboard 40b ** is opened and it conveys in the spreading room 33.
[0062] The supply means of electroconductive glue, gas supply opening 46c, exhaust-port 47c, and sample ejection gate 48b are prepared in the spreading room 33. The supply means of electroconductive glue is equipped with dispenser equipment 42, the tank 49 of electroconductive glue, and the alignment means 51. With this alignment means 51, alignment of the sample electrode terminal 38 and the dispenser equipment 42 is carried out, and the

electroconductive glue paste 43 needed for connection from dispenser equipment 42 is supplied on an electrode terminal 38.

[0063] In addition, instead of preparing in the supply means of electroconductive glue, the alignment means 51 may be formed in the conveyance means 45 side, and as long as it can carry out the alignment of dispenser equipment 42 and the electrode terminal 38 relatively, it may choose any. From gas supply opening 46c, a non-oxidizing gas is supplied like the middle room 44, and it considers as the gas ambient atmosphere of atmospheric pressure. As a type of gas, it is cheap and nitrogen gas with easy handling is practical.

[0064] According to this equipment, from the removal process of the oxide 39 formed in the electrode terminal 38 of a sample 34 to the spreading process of the electroconductive glue paste 43, since it carries out in a non-oxidizing gas ambient atmosphere, the electroconductive glue paste 43 can be applied without reoxidating the electrode terminal front face by which plasma treatment was carried out, and the connection resistance between electrode terminals can be certainly reduced by it.

[0065] Next, an example of the manufacture approach of the semiconductor device which used this equipment is explained. First, a semiconductor chip 34 is carried in from gate 48a of the plasma treatment room 32, and it installs on the cathode electrode 35. The plasma treatment room 32 supplies rare gas, such as Ar, from gas supply opening 46a, and holds an indoor ambient atmosphere under reduced pressure of 1-100Pa while exhausting it from exhaust-port 47a with a non-illustrated exhaust air pump.

[0066] The frequency of 1-30MHz and the power of 400-500W are supplied between the cathode electrode 35 and the anode electrode 36 from RF generator 50, high frequency discharge is produced by that cause, the plasma 37 is generated, and the oxide 39 of electrode terminal 38 front face of a semiconductor chip 34 is removed.

[0067] Next, movable dashboard 40a which forms the septum between the middle room 44 and the plasma treatment room 32 is opened, a sample 34 is carried in to the middle room 44 with the conveyance means 45, and movable dashboard 40a is closed after conveyance. The inert gas of Ar from gas supply opening 46b and N2 grade is supplied, and the middle room 44 sets the indoor ambient atmosphere as about 100-500Pa somewhat higher than the pressure of the plasma treatment room 32 while being beforehand exhausted with a non-illustrated exhaust air pump from exhaust-port 47b.

[0068] Next, after it introduces the inert gas of Ar and N2 grade into the middle room 44 and a pressure becomes ordinary pressure, movable diaphragm 40b is opened and it carries in to the spreading room 33 where the sample 34 was beforehand filled up with the conveyance fixture 41 into the inert gas of Ar and N2 grade from gas supply opening 46c. At the spreading room 33, alignment of dispenser equipment 42 and the electrode terminal 38 of a sample 34 is carried out with the alignment means 51, the electroconductive glue paste 43 of the specified quantity required for connection is supplied from dispenser equipment 42, and it applies on an electrode terminal 38.

[0069] After this equipment 31 removes the oxide 39 of an electrode terminal 38, formation of the electroconductive glue paste 43 is attained without touching the oxygen in atmospheric air, and manufacture of a semiconductor device with small connection resistance is performed.

[0070]

[Effect of the Invention] As explained in full detail above, this invention was able to attain the desired end referred to as reducing connection resistance in the inter-electrode connection using electroconductive glue. That is, in order that the surface of metal and electroconductive glue of an electrode terminal may contact directly in connection of electroconductive glue, a semiconductor device with small connection resistance is obtained.

[0071] Even if this does not use expensive Au or expensive Au plating electrode for an electrode terminal, electrode material, such as ordinary cheap Cu and aluminum, can be used, and there is a great thing the place which contributes on industry.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view of the semiconductor chip of the 1st example of this invention.
[Drawing 2] The sectional view from which the oxide film of the electrode terminal of drawing 1 was removed.
[Drawing 3] The sectional view in which electroconductive glue was formed on the electrode terminal of drawing 2 .
[Drawing 4] The sectional view which carried the semiconductor chip of drawing 3 in the mounting substrate.
[Drawing 5] The sectional view which formed under-filling in drawing 4 .
[Drawing 6] The sectional view of the ball grid array substrate of the 2nd example.
[Drawing 7] The sectional view from which the oxide film of the electrode terminal of drawing 6 was removed.
[Drawing 8] The sectional view in which electroconductive glue was formed on the electrode terminal of drawing 7 .
[Drawing 9] The sectional view of the mounting substrate of the 2nd example.
[Drawing 10] The sectional view from which the oxide film of the electrode terminal of drawing 10 was removed.
[Drawing 11] The sectional view which carried the semiconductor chip of drawing 7 in the mounting substrate of drawing 10 .
[Drawing 12] The sectional view of the wafer of the 3rd example.
[Drawing 13] The sectional view from which the oxide film of the electrode terminal of drawing 12 was removed.
[Drawing 14] The sectional view in which electroconductive glue was formed on the electrode terminal of drawing 13 .
[Drawing 15] The sectional view of the part from which the wafer of drawing 14 was cut.
[Drawing 16] The sectional view of the mounting substrate of the 3rd example.
[Drawing 17] The sectional view which carried the semiconductor chip of drawing 14 in drawing 16 , and formed under-filling.
[Drawing 18] The sectional view of the semiconductor chip of the 4th example.
[Drawing 19] The sectional view of the semiconductor fabrication machines and equipment of the 5th example.
[Description of Notations]
1, 8, 21, 34 .... Semiconductor chip
2, 6, 10, 15, 38 .... Electrode terminal,
3, 12, 16, 39 .... Scaling object,
4, 24, 43 .... Electroconductive glue (paste),
5 14 .... Mounting substrate,
7 .... Under-filling,
9 .... Ball grid array substrate,
11 .... Solder ball,
17 .... Wafer,

30 .... Oxide-film removal fixture,
31 .... Manufacturing installation,
32 -- Plasma treatment room,
33 .... Spreading room,
35 .... Cathode electrode,
36 .... Anode electrode,
37 .... Plasma,
40a, 40b .... Movable diaphragm,
41 .... Sample conveyance fixture,
42 .... Dispenser,
44 -- Middle room,
45 -- Conveyance means,
46 -- Gas supply opening,
47a, 47b, 47c -- Exhaust port,
48a, 48b -- Gate,
50 -- RF generator,
51 -- Alignment means.

[Translation done.]

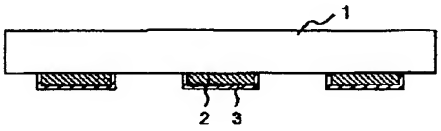
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

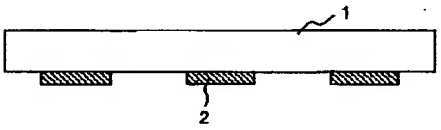
[Drawing 1]

図 1



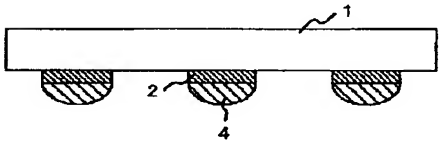
[Drawing 2]

図 2



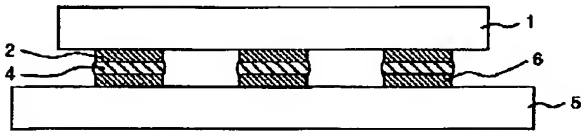
[Drawing 3]

図 3



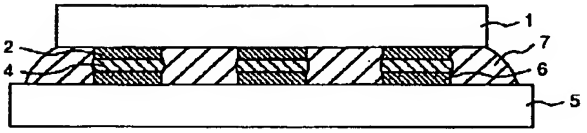
[Drawing 4]

図 4



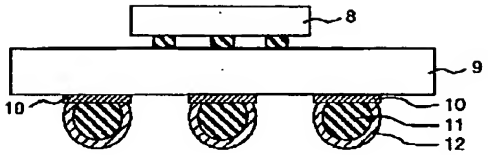
[Drawing 5]

図 5



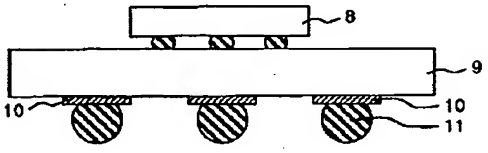
[Drawing 6]

図 6



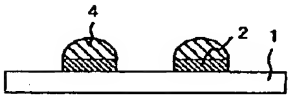
[Drawing 7]

図 7



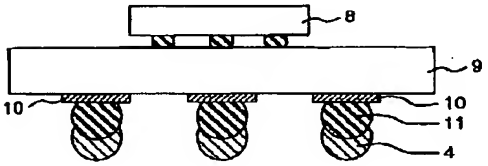
[Drawing 15]

図 15



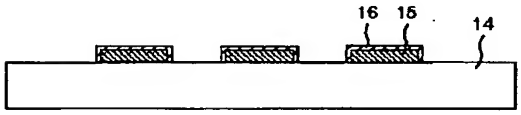
[Drawing 8]

図 8



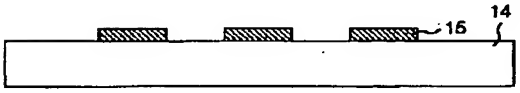
[Drawing 9]

図 9



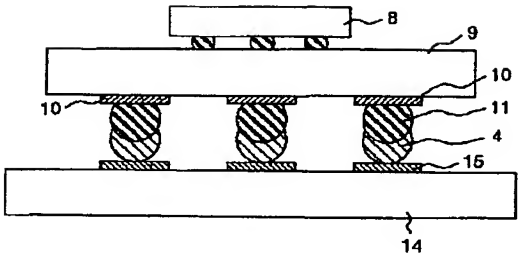
[Drawing 10]

図 10



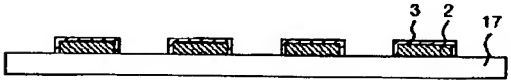
[Drawing 11]

図 11



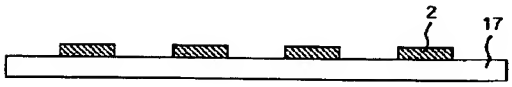
[Drawing 12]

図 12



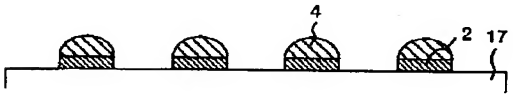
[Drawing 13]

図 13



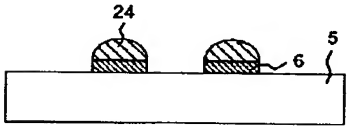
[Drawing 14]

図 14



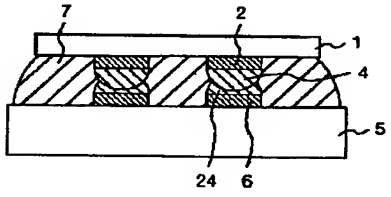
[Drawing 16]

図 16



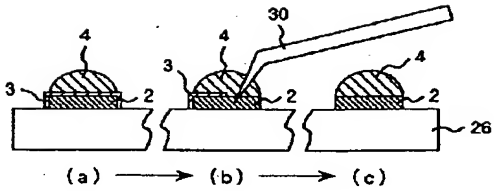
[Drawing 17]

図 17



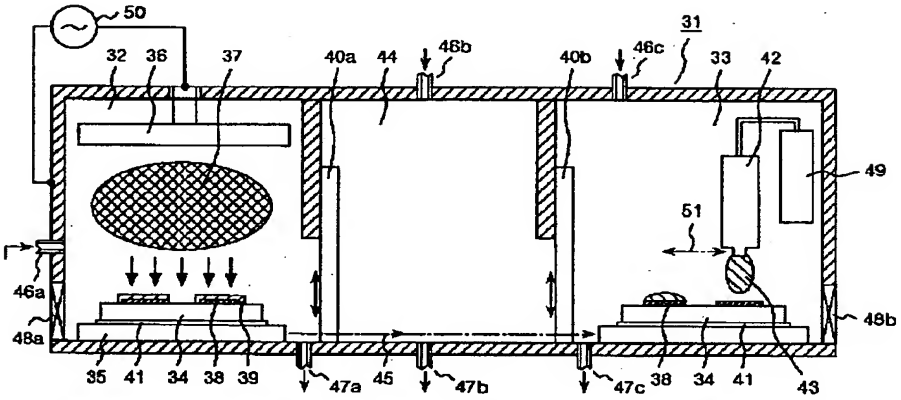
[Drawing 18]

図　１８



[Drawing 19]

図　１９



３１…製造装置　３２…プラズマ処理室　３３…塗布室　３４…半導体チップ　３５…カソード電極　３６…アノード電極
３７…プラズマ　３８…電極端子　３９…被覆酸化物　４０ａ，４０ｂ…可動仕切り板　４１…試料搬送治具
４２…ディスペンサー　４３…導電性接着剤（ペースト）　４４…中間室　４５…搬送手段　４６…ガス供給口
４７ａ，４７ｂ，４７ｃ…排気口　４８ａ，４８ｂ…ゲート　５０…高周波電源　５１…位置合わせ手段

[Translation done.]